

## Chapter I

### THE MORTALITY STUDY DESIGN

#### 1. The Study Population

The exposed study population, termed "Ranch Hand", was defined as those individuals who were formally assigned to the USAF organizations responsible for the aerial dissemination of herbicides and insecticides in the Republic of Vietnam from 1962 to 1971. These individuals were identified from historical data sources at the National Personnel Records Center (NPRC), St. Louis, Missouri and the USAF Human Resources Laboratory, Brooks Air Force Base, Texas. A total of 1,269 Ranch Hand personnel were eventually identified through this process. The comparison population was defined as those individuals who were assigned to a variety of cargo mission organizations throughout Southeast Asia during the same time period. Cargo mission aircrew members and support personnel were selected because of sufficient population size, similar training and military background experiences, and psychologic similarities to the Ranch Hand group. The comparison population was not occupationally exposed to herbicides or insecticides in the Republic of Vietnam. Identification of this population was completed using the same historical data sources as were used with the Ranch Hand population; 24,971 individuals were so identified. In preparation for matching the study and comparison populations, all subjects killed in action (KIA) were removed from the data base. The rationale for this action is the assumption that combat death in the Ranch Hand group was not caused by the immediate effects of herbicide exposure; KIA's were removed from the comparison group for comparability purposes. A KIA analysis will be performed in a subsequent report. The Ranch Hand KIA subgroup, numbering 22 individuals, although not matched, was maintained in the data base but was deleted from the mortality analysis, leaving 1247 Ranch Hand subjects.

The Ranch Hand population was matched to the comparison population with an iterative nearest-neighbor computer program (1). Up to 10 comparison subjects were matched to each Ranch Hand by year of birth, race (Black versus non-Black), and occupational category (officer pilot, navigator and other; enlisted flight engineer and other), thus creating matched sets of one study subject and up to 10 comparison subjects. All subjects are males. The mean age of the study subjects is 45 years.

Following the original match, the majority of Ranch Handers had 10 comparisons. The exceptions were the group of non-Black pilots who had a mean of only 9.5 comparisons per exposed subject due to the extreme ages of several individuals, and the strata of Black pilots and other Black officers who only had means of 2.7 and 5.0, respectively. In December 1981, the USAF Principal Investigators learned that several morbidity study comparison subjects had reported no experience in Southeast Asia, suggesting that overselection of the comparison population had occurred (1). Manual review of the comparison subjects' military personnel records revealed that 18 percent of the 12,193 comparison individuals in the original match were ineligible for study. The inadvertent inclusion of several non-Southeast Asia organizations resulted in the selection of these inappropriate individuals. These ineligible subjects were found to be randomly distributed throughout the matched sets and were removed from the study. Following the removal of the

ineligible subjects, the study was reduced to a 1:8 design. Also during this period, five Ranch Hand subjects were identified through personnel record sources and Veterans Administration Education Benefits and Financial Records. These five individuals had not been identified earlier because the majority of their military personnel records had been destroyed in a fire at the NPRC in St. Louis. Three of these five were newly found Ranch Handlers and two were comparisons subsequently identified as Ranch Handlers. No attempt was made to match comparisons to these five new Ranch Handlers. During the removal of ineligible subjects, one Ranch Handler, a Black officer pilot, lost his only comparison and remains unmatched, giving a total of six unmatched Ranch Handlers. All six of these unmatched Ranch Handlers are included in the morbidity and mortality studies. They were used in the analyses where appropriate, in order to improve statistical power.

## 2. The Mortality Population

Five comparisons per exposed subject were considered more than adequate for mortality analyses; this estimate has recently been verified under a multiplicative model by Breslow, et al. (5). Up to five comparisons in each matched set, were identified from the 1:8 cohort as the mortality comparisons. Since the positions of the individuals in the matched sets had already been randomized in the data file, the selection of the first five positions in each matched set array for membership in the mortality comparison resulted in a random selection of the mortality comparison cohort. If a Ranch Handler had at least one but no more than five comparisons after removal of the ineligibles, then all of his matched set were used in the mortality component of this study. The mortality population is, therefore, defined as the 1241 matched Ranch Handlers and their randomly chosen mortality comparisons (6171 individuals) and the six unmatched Ranch Handlers. Table 1 summarizes the mortality population by occupational category and race. Here, and elsewhere in this report, non-Black is defined as Caucasian, Mexican or Oriental.

Table 1

### MORTALITY POPULATION SUMMARY BY OCCUPATION AND RACE

<u>Occupation, Race</u>	<u>Counts</u>	
	<u>Ranch Hand</u>	<u>Comparison</u>
Officer-Pilot, Non-Black	349	1740
Officer-Pilot, Black	6	13
Officer-Navigator, Non-Black	80	390
Officer-Navigator, Black	2	10
Officer-Other, Non-Black	25	123
Officer-Other, Black	1	2
Enlisted-Flt Eng, Non-Black	189	935
Enlisted-Flt Eng, Black	15	75
Enlisted-Other, Non-Black	528	2628
Enlisted-Other, Black	52	255
	<u>1247</u>	<u>6171</u>

The overall match ratio,  $6171/1247=4.95$ , reflects the lack of suitable controls in some strata, the subsequent removal of ineligible comparisons and the addition of five unmatched Ranch Handers. A detailed description of the matching results is given in Appendix III.

Those Ranch Handers having fewer than five matched mortality controls are summarized in Table 2.

Table 2

RANCH HAND SUBJECTS WITH LESS THAN FIVE COMPARISON SUBJECTS

Occupation, Race	Counts		Notes
	Ranch Hand	Comparisons <sup>3</sup>	
Officer-Pilot, Non-Black	1	2	1
	1	3	1
Officer-Pilot, Black	1	0	1
	1	1	1
	2	2	1
	1	3	1
Officer-Navigator, Non-Black	2	0	2
Officer-Other, Non-Black	2	4	1
Officer-Other, Black	1	2	1
Enlisted-Flt Eng, Non-Black	2	0	2
Enlisted-Other, Non-Black	12	4	1
Enlisted-Other, Black	1	0	2
	<u>27</u>		

Note 1. Lack of suitable comparison subject or loss due to ineligibility.

Note 2. New Ranch Handler, no attempt to match.

Note 3. Comparisons per Ranch Handler